P03JEX013EP

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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : G01F 23/36, 23/38, 23/60, 23/62, H01C 10/34 — A1

(11) International Publication Number: WO 94/27119

(43) International Publication Date: 24 November 1994 (24.11.94)

(21) International Application Number: PCT/AU94/00239

(22) International Filing Date: 10 May 1994 (10.05.94)

(30) Priority Data:
PL 8734 10 May 1993 (10.05.93) AU

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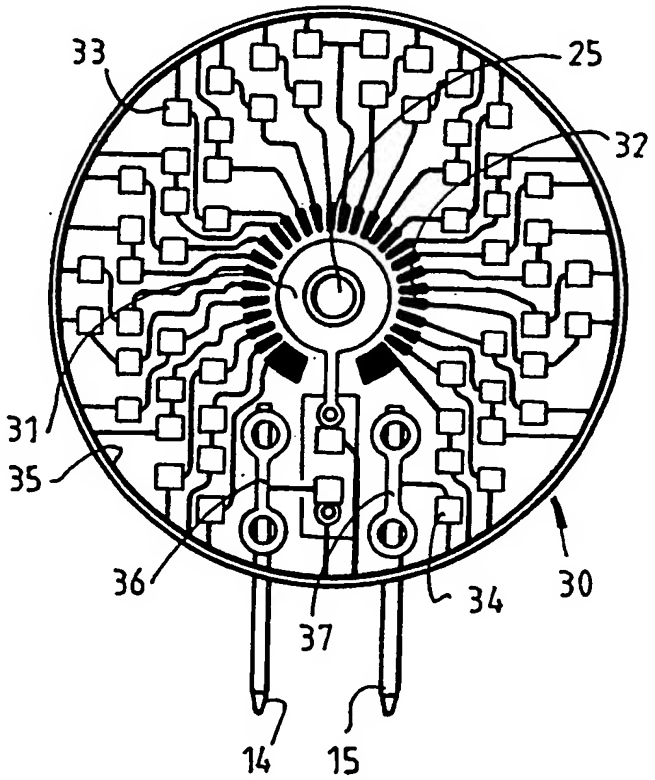
(81) Designated States: AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, ES, FI, GB, GE, HU, JP, KG, KP, KR, KZ, LK, LU, LV, MD, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SI, SK, TJ, TT, UA, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: VARIABLE RESISTANCE DEVICE

(57) Abstract

A variable resistance device which includes a first annular contact member (31), a second annular contact member (32) coaxial with the first annular contact and being segmented, at least one resistance (33) connected to each segment, and a contact member (40) coaxially rotatable relative to the annular contact members which is at all times in contact with the first annular contact member (31) and which can selectively contact individual ones of the segments (32) so as to provide a variable resistance. The device is particularly suitable for use in a level gauge for and LPG tank and has a body (10), a magnet assembly (20) within the body and which is associated with the rotatable contact member (40) and rotates therewith, the magnet assembly being associated with a rotatable magnet assembly within the tank so that the position of the rotatable contact member reflects the position of the magnet in the tank.



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VARIABLE RESISTANCE DEVICE

This invention relates to a variable resistance device and in particular to such a device which is particularly suitable for use in a fuel gauge and sender for use with liquid petroleum gas (LPG) tanks.

Gauges of the type to which the inventions, in the exemplified sense, have been known and, in general terms, they include a body in which there is located a rotating member which carries three components. The first is a magnet which is attached to the rear, as we will define it of the device, a wiper arm, and an indicating needle or the like.

Associated with the rotating member, there can be a face plate or the like which is graduated and is adapted to be mounted behind the indicating needle to give an indication of level and an annular wound coil which is adapted to be located coaxially with the member and to be contacted by the wiper so as to form a variable resistance.

Outputs are provided which permit the resistance to be placed in circuit to give a remote indication of the position of the rotatable member.

The device, as a whole, is adapted to abut a normally sealed tank

with the magnet in operative alignment with a rotating shaft within the tank which shaft can have associated therewith a corresponding magnet, the shaft being driven by a float so as to adopt a particular angular orientation for any particular volume of liquid in the tank.

The two magnets interact so that as the rotatable shaft in the tank is rotated by movement of the float so the two magnets remain in an effectively fixed alignment, that is that the rotatable member in the gauge rotates with the rotatable shaft and there is an indication of the position of the float.

These gauges, whilst more or less satisfactory, have had two basic problems.

The major one of these is that the movement of the float in the gas tank is not linear.

It will be appreciated that gas tanks are normally cylindrical and even if the float is located to move in a vertical plane transverse to the axis of the tank and the float itself passes through the axis in its movement, it will be appreciated that equal changes in heights of the liquid in the tank will represent different volumes with the volumes adjacent the full and empty positions being very substantially less than those in the intermediate positions, and, if the float is moving in an arc, this is exacerbated. Because of this, if it is required to

provide a linear output, then the coil winding has to be done in such a way as to take into account these variations in volume.

Further, for tanks of different shapes, and/or tanks having the float located in different positions, then there has to be a different coil winding for each such tank. Further, different users of devices of this type may require different maximum resistances which, again, necessitate differently wound coils.

The second difficulty which has been found with rheostat type devices is that, after a period of use, there can be wear on the wiring of the coil which wear causes variations in the contact between the wiper and the coil and thus of the indicated resistance with time.

It is a first object of the present invention to provide a variable resistance device which can readily be modified to provide required outputs and it is also an object to provide such a device which minimises mechanical difficulties which have previously occurred.

The invention, in its broadest sense, provides a variable resistance device which includes a first annular contact member, a second annular contact member coaxial with the first annular contact and being segmented, at least one resistance connected to each segment, and a contact member coaxially rotatable relative to the annular contact members which is at all times in

contact with the first annular contact member and which can selectively contact individual ones of the segments so as to provide a variable resistance.

It is a feature of the invention that the individual resistances can be selected to provide a value appropriate to the required value at any particular point of contact.

In a particular aspect of the invention when it is applied to a liquid gauge associated with an LPG tank or the like, the rotatable contact member rotates with an assembly which is provided with at least one magnet on its inner end and which is rotated by the rotation of a complimentary magnet within the tank.

It is a feature of this invention that we provide a pair of magnets diametrically spaced relative to the axis of rotation which cooperate with at least one magnet on a shaft rotated by movement of the float to cause the rotatable contact member to assume the required position.

In the LPG cylinder valve application, there may be a needle pointer in association with a scale to give an indication of the level of liquid in the tank.

Also, I may prefer to provide the unit in a sealed container which may have means whereby it can be directly connected to a

device with which it is used or be adapted to be received in a carrier which can be connected thereto.

In order that the invention may be more readily understood, we will describe, in relation to the accompanying drawings. one particular form of resistance device made in accordance with the invention.

In these drawings:

Figure 1 is a front perspective view of a device for use with an LPG cylinder;

Figure 2 is a section along line 2-2 of Figure 1 looking in the direction of the arrows;

Figure 3 is a view of the rear of the circuit board carrying the resistances; and

Figure 4 is an elevation of the wiper.

Whilst the resistance device to be described is described in relation to one to provide an indication of the fuel contained in an LPG gas tank, it is to be understood that the device can equally be well applied to other applications where it is desired to provide a variable resistance which may need to have characteristic not readily provided by an annular coil, specifically one which is not required to provide an output which has a regular relationship with the position of a wiper.

As described earlier, liquid level gauges of this general type

are well known and physically the gauge of the invention, as illustrated in Figure 1, can be of the same dimensions and the same general physical appearance as previously known gauges.

The gauge may have a body 10 which is substantially cylindrical and may be of the order of 30 to 35 millimetres in diameter and within this body 10, there is mounted a calibrated card 19.

The body may be made to two components 12, 13 of a transparent injection moulded plastics material which are interconnected to effectively seal the gauge.

Extending outwardly from the gauge there may be a pair of contacts 14, and, as is conventional, these are located as to extend from the front face of the body as the gauge will normally be located against or in a recess in a gas tank. The contacts 14 enable connection to a repeater gauge located in the vehicle or other device with which the gas tank is associated.

Assuming the tank is in a motor vehicle, the manufacturer may provide a gauge in his normal instrument panel assembly, if gas is to be provided as original equipment, or the fitter could provide a separate gauge normally mounted on, under or otherwise associated with the dash. In either case, such a gauge is operated from the sender on the LPG tank.

The particular construction of the casing will not be further

described except to say that for some applications, we may provide a ring or the like 16 which can receive the gauge and which itself can have fitting lugs 17 or the like so that the gauge can be fitted to a surface. Alternatively, we could provide fitting means as part of the moulding of the body.

Located in the body and adapted for rotation therewith is a magnet assembly 20 which includes a recess 21 which receives an extension 22 extending inwardly from effectively the centre of the body component 12. The magnet assembly has a rotatable member 23 axially thereof and extending outwardly therefrom.

The magnet assembly may itself be a cylindrical moulding and in a preferred embodiment can have a pair of magnets, not illustrated, mounted diametrically therein and with different poles pointing outwardly.

These magnets as indicated earlier herein provide the means for coupling the magnet assembly 20 with a corresponding assembly associated with a rotatable member in the gas tank which rotatable member is rotated by movement of a float which would normally have a toothed quadrant engaging a gear wheel coaxially with the rotatable member. This will not be further described.

In the body 10 and adjacent the front thereof, there can be the calibrated card 19 through which the outwardly directed member 23 passes and the outwardly directed member has a needle pointer

24 or the like connected thereto. This pointer 24 registers against the calibrations on the card 19.

The outwardly directed member 23 may be held in a bearing 25 in a circuit board 30, to be described later herein, to ensure, in association with the recess 21 and the extension 22, ready rotation of the magnet assembly.

The foregoing can, as mentioned, be very similar to conventional arrangements and are not, in themselves, critical to the invention.

The means to obtain a required resistance which varies with the orientation of the rotatable member comprises a wiper 40 and a resistance assembly comprising a circuit board 30.

It is to be appreciated that the wiper 40 as shown in Figure 4 is at a very much larger scale than the circuit board 30 as illustrated in Figure 3. The diameter of the wiper 40 is effectively the same as the diameter of the segmented contacts 32.

Referring generally to Figure 3, we show a circuit board arrangement which in practice would have an overall diameter of less than 30 millimetres and has a first annular contact member 31 and the surrounding segmented contacts 32 previously referred to.

Connected to each of the contact segments 32, there is at least one resistance 33 and in most cases two resistances in series which resistances can be in the form of surface mount resistances. Each of the resistance sets are connected in series with resistance 34, being connected to a conducting portion 35 on the circuit board and resistance 34 is, in turn, in connection by way of a conductor 37 with the blade connector 15.

The annular contact member 31 is in connection with a second conducting portion 36 to which, in turn, the blade connector 14 is connected.

The wiper 40, as shown from Figure 2, is located on the magnet assembly 20 and this has three upwardly extending wiper arms 41, 42 and 43, only two of which are seen in Figure 2, arms 41 and 42 both being in connection with the annular contact member 31 and arm 43 being in connection with the segmented contacts 32.

It will be seen that there is a continuous circuit formed between the blade connector 14 by way of the annular contact member 31, wiper arms 41, 42, the wiper 40, the wiper arm 43, the segmented contact members 32, the resistances 33, the conducting portion 35, and the blade connector 15.

Thus depending upon the total value of the resistances 33 associated with any segment, so the resistance between the blades 14 and 15 for any particular angular position of the wiper 40,

and that is the position of the magnet assembly 20, will be fixed.

The wiper may be in contact with two segments 32 at any time but the effective total resistance will be equivalent to that of the "lower value" segment as the other resistance is shorted out.

It will be seen that an arrangement such as that proposed has very substantial benefits in that, for any particular required output resistance or arrangement of resistance, it is only necessary to change the surface mount resistors on the circuit board and all other components will remain identical.

This would mean, in more general terms that if it was required to provide a linear logarithmic anti-logarithmic or other variable form of output, this could also be achieved simply by the correct selection of the resistors on the circuit board.

This would not only provide a very flexible arrangement for gas fuel gauges but also a most satisfactory arrangement where other forms of variable resistances are required to be used.

Again, whilst we have described one particular form of the invention specifically as applied to LPG fuel gauges, the invention can be used wherever a variable resistance is required and particularly where such a resistance which does not follow a smooth curve, such as linear, log or anti-log is required.

The claims defining the invention are as follows:

1. A variable resistance device which includes a first annular contact member, a second annular contact member coaxial with the first annular contact and being segmented, at least one resistance connected to each segment, and a contact member coaxially rotatable relative to the annular contact members which is at all times in contact with the first annular contact member and which can selectively contact individual ones of the segments so as to provide a variable resistance.

2. A variable resistance device as claimed in claim 1 wherein the resistances connected to each segment are connected at their other end to a common conductor, the variable resistance being between the first annular contact member and the common conductor.

3. A variable resistance device as claimed in claim 1 or claim 2 wherein the individual resistances can be selected to provide a value appropriate to the required value at any particular point of contact.

4. A variable resistance as claimed in claim 3 wherein the rotatable contact member and the common conductor are each connected to a terminal whereby electrical connection can be made therewith.

5. A variable resistance device as claimed in any one of claims 1 to 4 wherein, when it is applied to provide a liquid gauge associated with an LPG tank or the like, the rotatable contact member rotates with an assembly which is provided with at least one magnet on its inner end and which is rotated by the rotation of a complimentary magnet within the tank.

6. A variable resistance device as claimed in claim 5 wherein there are a pair of magnets diametrically spaced relative to the axis of rotation which cooperate with at least one magnet on a shaft rotated by movement of the float within the tank to cause the rotatable contact member to assume the required position.

7. A variable resistance device as claimed in either of claims 5 or 6 wherein there is a needle pointer in association with a scale to give an indication of the level of liquid in the tank.

8. A variable resistance device as claimed in any one of claims 5 to 7 wherein the unit is in a sealed container which has means whereby it can be directly connected to a device with which it is used or be adapted to be received in a carrier which can be connected thereto.

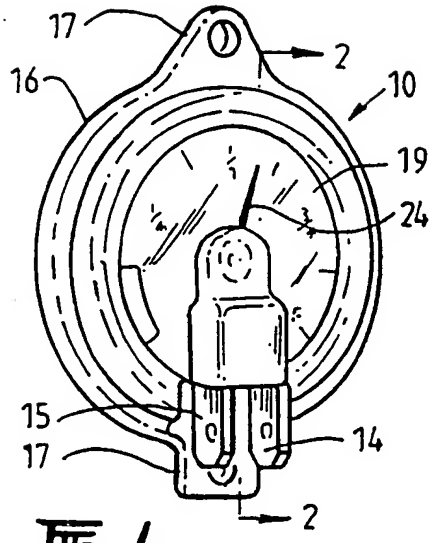

Fig. 1.

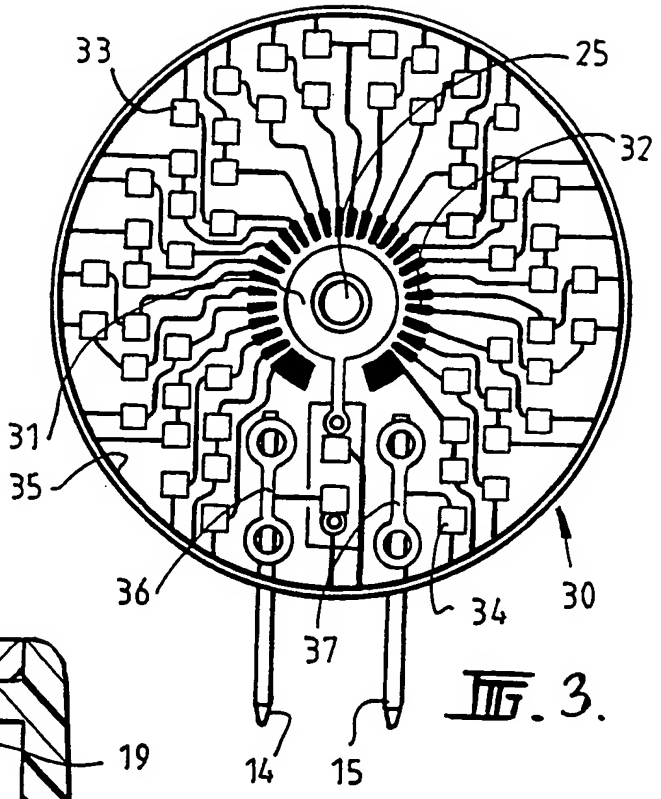

Fig. 3.

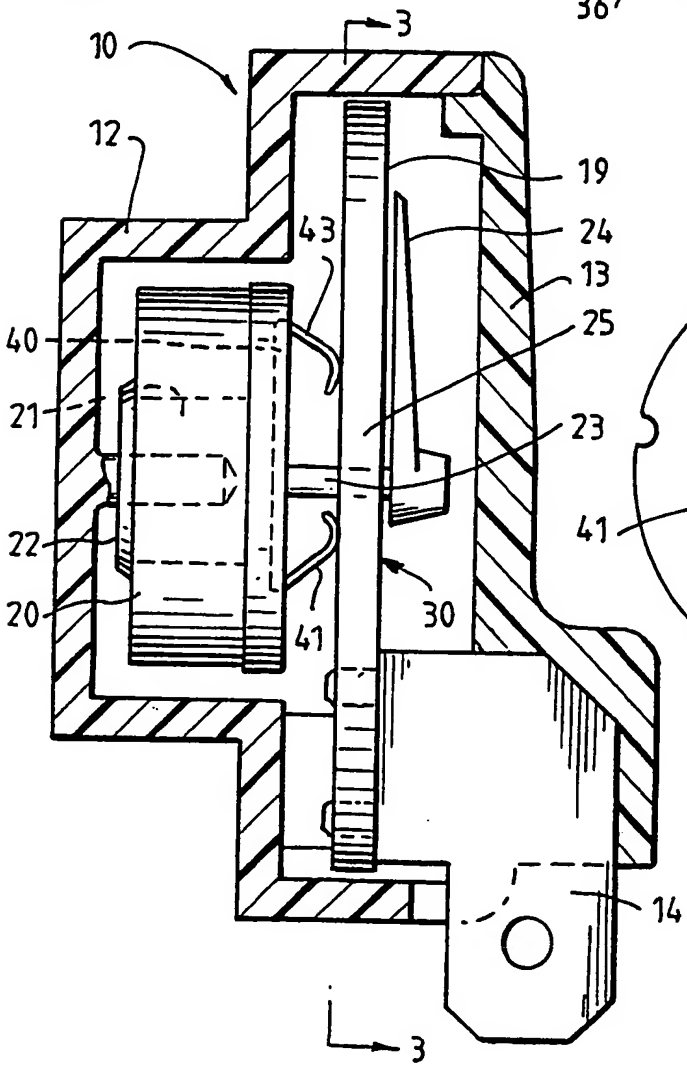

Fig. 2.

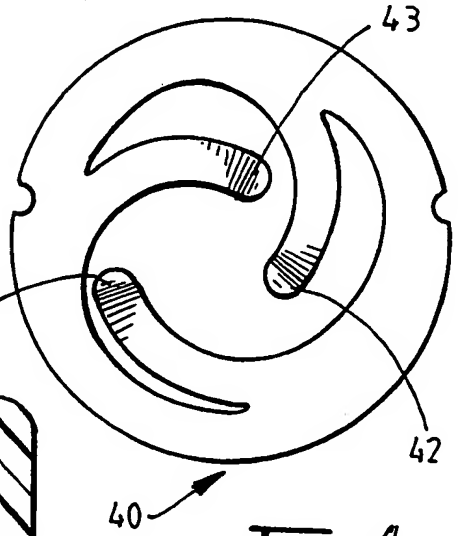

Fig. 4.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 94/00239

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl.[5] G01F 23/36, 23/38, 23/60, 23/62, H01C 10/34

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC : G01F 23/36, 23/38, 23/60, 23/62, 23/46, 23/44, 23/68, 23/10, 23/12; H01C 10/30, 10/32, 10/34

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU : IPC as above, Australian Classification 04.72

Electronic data base consulted during the international search (name of data base, and where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
X	E.H. Werwinck, "Electric Motor Handbook", published 1968 by McGraw-Hill Book Co. (UK Ltd) pages 440-441	1-4
X	A. Gray & G.A. Wallace, "Principles and Practice of Electrical Engineering", published 1947 by McGraw-Hill Book Co. Inc. pages 55-56	1-4

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search
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Date of mailing of the international search report
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International application No.
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate of the relevant passages	Relevant to Claim No.
X	J. Nadon & B. Gelmine, "Industrial Electricity", published 1951 by D. Van Nostrand Company Inc. pages 210-212	1-4
X	H. James & L. Markle, "Controllers for Electric Motors" published 1952 by McGraw-Hill Book Co. Inc. pages 14-18	1-4
X	AU,A, 24312/57 (220811) (PHOTO PRINTED CIRCUIT LTD) 4 July 1957 (04.07.57) see page 4 line 6 - page 5 line 6, figs 4-6	1-4
A	US,A, 5117693 (DUKSA) 2 June 1992 (02.06.92) see abstract	1-8
P,A	US,A, 5305639 (PONTEFRACT) 26 April 1994 (26.04.94) see abstract	1-8
A	US,A, 4557144 (LUCCHINI) 10 December 1985 (10.12.85) see abstract	1-8

INTERNATIONAL SEARCH REPORT
Information on patent family membe.

International application No.
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This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	5305639	EP	593085				
US	4557144	FR	2533694	DE	3330871	ES	273669
		GB	2127974	IT	8253724		
							END OF ANNEX